Lipid profiles associated with MACEs among hemodialysis patients with percutaneous coronary intervention: from the FU-Registry

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Short title: Lipid profiles and MACEs in HD patients with PCI

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Abstract

Background: It is well known that percutaneous coronary intervention (PCI) in hemodialysis (HD) patients is associated with higher rates of in-stent restenosis (ISR) and major adverse cardiovascular events (MACEs) compared to those in non-HD patients, even if the cholesterol management target value is achieved.

Methods: From among 2,148 patients (2,568 lesions) who underwent PCI in our database of the FU-Registry [UMIN000005679, Fukuoka University Hospital EC/IRB:10-1-08(09-105)], we selected 142 HD patients (164 lesions) without ACS (acute coronary syndrome) and divided them into 90 patients (111 lesions) without MACEs [MACEs(-) group] and 52 (53 lesions) with MACEs [MACEs(+)], and evaluated the factors to related MACEs(+).

Results: Total cholesterol (TC: 166±39mg/dL vs 150±30mg/dL, p=0.02) and HDL-C (47.8±13.5mg/dL vs 40.1±14.7mg/dL, p=0.01) levels were significantly lower in the MACEs(+) group at PCI. No significant differences were observed in other parameters, including TG, LDL-C, LDL-C/HDL-C ratio, and % changes in HDL-C, non-HDL-C, LDL-C, and HbA1c between before and after PCI. TC, LDL-C and non-HDL-C at the time of PCI and TC and HDL-C at the 9-months follow-up were each negatively correlated with MACEs, while BMI [OR 0.83 (95%CI: 0.69-0.99)], prior CABG [OR 3.54 (95%CI: 1.02-13.43)] and insulin use [OR 3.37(95%CI: 1.18-10.25)] were strongly correlated with MACEs in a multivariate analysis.

Conclusion: The results suggest that the application of lipid management for non-HD patients to HD patients at the time of PCI may not necessarily be beneficial for the medium-term clinical outcomes, but BMI, Prior CABG and insulin use are better predictors of MACEs.

Introduction

It is well known that percutaneous coronary intervention (PCI) in HD patients is associated with higher rates of ISR (in-stent restenosis) and MACEs (major adverse cardiovascular events) than those in non-HD patients even if the cholesterol management target value is achieved[1, 2]. Although hyperlipoproteinemia seems to be an essential and important risk factor for cardiovascular disease, HD patients have characteristics that are different from those of non-HD patients. In HD patients, a decrease in lipoprotein lipase activity causes an increase in both very-low-density lipoprotein (VLDL) and chylomicron remnant. A decrease in the hepatic triacylglycerol lipase (HTGL) level leads to an increase in intermediate density lipoprotein (IDL), and an increase in TG-rich lipoprotein is considered to be an elevation of serum TG[3-5]. HTGL also affects the fractional catabolic rate of apo A-I, the major apolipoprotein of HDL; an increase in the catabolic rate of apo A-I is associated with a low HDL-C[6]. In addition, a decrease in lecithin-cholesterol acyltransferase (LCAT) activity causes a decrease in HDL-C[7, 8] and a decrease in HTGL, as mentioned above, causes a decrease in LDL-C[9]. In the AURORA trial[10], the LDL cholesterol (LDL-C) level in HD patients was not higher than that in non-HD patients, and the administration of statins in HD patients decreased LDL-C levels with no reduction in cardiovascular risk. Therefore, based on the hypothesis that there is a large difference in the correlations between lipoprotein parameters and the incidence of MACEs for chronic HD and non-HD patients who undergo PCI, we divided HD patients who underwent PCI into two groups; those with MACEs [MACEs(+) group] and without MACEs [MACEs(-) group], and evaluated factors related to MACEs.

Methods

Subjects

From among 2,148 patients (2,568 lesions) who underwent PCI from January 2003 to June 2012 at Fukuoka University Hospital, Fukuoka University Chikushi Hospital and Fukuoka White-Cross Hospital, we selected 142 HD patients with PCI (164 lesions) without ACS (acute coronary syndrome), and divided them into a MACEs(-) group (90 cases, 111 lesions) and a MACEs(+) group (52 cases, 53 lesions) (Fig. 1). We performed an angiographical analysis using the database from the FU-Registry[11, 12] [UMIN000005679, Fukuoka University Hospital EC/IRB:10-1-08(09-105)]. After an average of about 300 days after PCI, all of the patients underwent a clinical follow-up to determine the presence of MACEs based on findings at the

last visit and a phone call. Angiographic follow-up was performed for approximately 91.5% of all cases. All-cause myocardial infarction and target lesion revascularization (TLR) were defined as MACEs. Myocardial infarction included both ST-T elevation and non-ST-T elevation types, which exhibit either distinctive ischemic electrocardiogram changes or elevated cardiogenic enzymes (simple troponin T positive, CK more than twice the reference value, CK-MB greater than the upper limit of the reference value). Further, stent thrombosis was defined to include definite, probable and possible types according to the ARC (Academic Research Consortium) definition.

PCI・IVUS (intravascular ultrasound)

PCI was performed in patients with more than 50% significant stenosis by angiography who also showed chest symptoms or evidence of ischemia by a non-invasive test (treadmill electrocardiogram, myocardial scintigraphy). The endpoint for PCI was determined to be the absence of any dissection that might obstruct blood flow to achieve TIMI III flow with 10% or less angiographic stenosis. Even though individual operators determined whether or not IVUS should be performed, about 40% of the overall patients underwent detailed measurement, since the subjects were HD patients and IVUS was not effective in many cases. Since the results of pre-procedural IVUS included many cases in which IVUS was not able to pass through lesions, they were not included in the present analysis and only the results of post-procedural IVUS were used.

Medication (antiplatelets)

With regard to the use of antiplatelets, the administration of biaspirin and 200mg of ticlopidine or 75mg of clopidogrel was started in all cases at least 48 hours before stent insertion. In principle, antiplatelets other than biaspirin were administrated continuously for at least two weeks in patients with a BMS (bare metal stent) and all antiplatelets were administered for at least nine months after surgery in patients with an indwelling DES (drug eluting stent).

QCA

QCA was performed randomly for about 70% of the total lesions. Quantitative and qualitative analyses were performed using CMS-GFT (MEDES, The Netherlands) at Fukuoka University, which was the core laboratory for the study as described previously[12-16]. An analysis was performed for angiograms obtained at pre-procedural and post-procedural follow-up. All measurements were performed based on angiography after the intracoronary injection of nitroglycerin. Segments were defined as the in-stent region, the proximal edge of the stent

and a region 0.5mm away from the distal edge, respectively. Late loss was defined as the difference in the minimum lesion diameter (MLD) between the post-procedural angiogram and the follow-up angiogram. In addition, restenosis was defined as a stenosis rate of 50% or higher, as described previously[12].

Statistical analysis

Statistical analysis was performed using SAS software (Version 9.1 SAS Institute, Cary, NC, USA) at Fukuoka University. The chi-square test was used to compare categorical variables between groups. The Wilcoxon rank-sum test and Student T test were used to compare continuous variables between groups, which were expressed as the mean±STD. A value of $p<0.05$ was considered to reflect statistical significance. A multivariate analysis was performed using multiple logistic analyses.

Results

With regard to the patient background, the MACEs(+) group showed significantly lower incidences of UCG-LVEF (58.6% vs 53.0%, p=0.02), TC (173±44mg/dL vs 158±34mg/dL, p=0.03), LDL-C (104±36mg/dL vs 90±25mg/dL, p=0.01) and uric acid (UA) (6.1±1.7mg/dL vs 5.3±1.8mg/dL, p=0.07), compared to the MACEs(-) group. Even though no difference in albumin was observed between the groups, BMI was significantly lower (21.5±3.8kg/m^2 vs 20.3±2.3kg/m^2, p=0.02) in the MACEs(+) group. With regard to prior/complicating disease, the MACEs(+) group had significantly ($p<0.01$) higher percentages of prior MI and prior CABG.

While BMI at the time of PCI-follow-up (after an average of 300 days) was significantly lower (21.1±3.2kg/m^2 vs 20.0±1.8kg/m^2, p=0.01) in the MACEs(+) group, similar to the results observed at the time of PCI, there were no significant differences in the percent reduction in BMI. At the follow-up, TC (166±39mg/dL vs 150±30mg/dL, p=0.02) and HDL-C (47.8±13.5mg/dL vs 40.1±14.7mg/dL, p=0.01) were significantly lower in the MACEs(+) group, compared to the MACEs(-) group. No significant differences were observed in other parameters, such as TG, LDL-C, L/H ratio, or % changes in HDL-C, non-HDL-C, LDL-C or HbA1c (Table 1).

At the time of PCI, there was no difference in the % use of antihypertensive drugs and statins, or in the incidence of complicating DM between the groups, while the MACEs(+) group showed a significantly higher percentage of insulin use (24.4% vs 44.2%, p=0.02). The MACEs (+) group

also showed significantly higher use rates for nitrates and insulin at the time of follow-up (Table 2).

Among the lesion characteristics, while there was no significant difference in the percentage of extensive calcification, the MACEs(+) group showed significantly higher percentages of pre-in-stent restenosis (31.5% vs 49.1%, $p<0.05$) and LMT lesion (4.5% vs 26.4%, $p<0.001$), and a tendency for a lower use rate of DES (64.9% vs 47.2%, $p=0.10$). The results of pre- and post-procedural QCA and IVUS were similar in the two groups (Table 3). With regard to the clinical outcome, the frequencies of MACEs, i.e., TLR, death, stent thrombus, MI and TLR-CABG, were 80.8%, 15.4%, 13.5%, 9.6% and 3.9%, respectively (Table 4).

In a univariate analysis of the correlation between lipoprotein parameters and MACEs, negative correlations were seen between MACEs and TC, LDL-C, and non-HDL-C at the time of PCI, as well as TC and HDL-C at the time of follow-up. In a multivariate analysis for factors for which a significant difference was found between the two groups in the univariate analysis, significant ($p<0.05$) correlations were found between MACEs and BMI [odds ratio, 0.83 (0.69-0.99)], prior CABG [odds ratio, 3.54 (1.02-13.43)] and insulin use [odds ratio, 3.37 (1.18-10.25)] (Table 5).

Discussion

According to the Japanese Society for Dialysis Therapy, the number of maintenance hemodialysis (HD) patients increases steadily every year, and reached 309,946 in December 2012[17]. Approximately 63% of HD patients who are hospitalized due to cardiac disease have ischemic cardiac disease[18], and cardiac death accounts for more than 30% of all deaths in Japan[17]. Charytan et al.[19] reported that 42% of asymptomatic HD patients suffer significant coronary stenosis, and thus HD patients are considered to be at very high risk for CAD. The high incidences of stent restenosis and the development of new coronary artery lesions including ACS are problems for HD patients after PCI, even in a country with a low risk of CAD like Japan[1].

It is well known that medium- and long-term clinical outcomes can be affected by an abnormal lipid metabolism. However, in the AURORA trial[10], in which 2,776 HD patients were divided into a placebo group and a group that received rosuvastatin at 10mg/day, the combined endpoint of cardiovascular death, non-fatal myocardial infarction and non-fatal cerebral vascular

disorder was not significantly reduced, with a decrease of only 4%. In addition, in 2005, the 4D study, in which 1,255 HD patients with diabetes mellitus were randomly assigned to receive either 20 mg of atorvastatin per day or matching placebo, did not show a significant reduction in the primary endpoint[20]. The SHARP trial was conducted in 9,720 patients with chronic kidney disease with no known history of cardiovascular disease, and 33% of the patients were on HD[21]. Patients were assigned to receive either simvastatin 20mg plus ezetimibe 10mg daily or placebo with a median follow-up of 4.9 years. This combination therapy reduced the incidence of major atherosclerotic events in a wide range of chronic kidney disease (CKD). After weighting for the reduction in LDL-C, the proportional reductions in major atherosclerotic events per 1mmol/L reduction in LDL-C were similar for stage 4 and 5 CKD, however, the subgroup of patients with dialysis showed no significant benefit with treatment. These findings suggest that we should not expect to see an overall decrease in the risk of cardiovascular disease for patients who are receiving HD therapy under lipid-lowering therapy based on statins.

In the present study, we divided stable angina patients who were receiving maintenance HD into two groups according to the presence or absence of MACEs. Even though the MACEs(+) group showed a significantly lower LDL-C level, no significant correlation with MACEs was observed in a multivariate analysis. Further, an examination of the correlation between statin use and MACEs showed an odds ratio (OR) of 1.27 (CI: 0.54-2.9), and thus we could not confirm the effectiveness of statins, similar to the results of the AURORA and 4D trials.

Since LDL-C is generally an important risk factor for MACEs, as shown in the MEGA[22], MEGA-CKD[23], or other studies[24], we compared the correlations between lipoprotein parameters and the incidence of MACEs in 1,578 non-HD patients with stable angina (number of lesions: 1909, pre-LDL-C: 106±48mg/dL, post- LDL-C: 93±29mg/dL) to the results in 142 HD patients in our FU-Registry analysis (Fig. 2-A). The results showed that LDL-C level, TC and non-HDL-C were significantly correlated with MACEs, but the correlation observed in non-HD patients was opposite that seen in HD patients. We stratified LDL-C into five groups (LDL-C<80mg/dL, 80-100mg/dL, 100-120mg/dL, 120-140mg/dL and 140mg/dL<LDL-C), and the correlation between LDL-C and the incidence of MACEs was investigated in each group (Fig. 2-B). The results showed that the risk of MACEs increases as the LDL-C level increases in the non-HD group, and a significant correlation was seen between MACEs and the LDL-C value, especially in the groups with LDL-C<80mg/dL and 140mg/dL<LDL-C. Conversely, no significant correlation was observed between MACEs and the LDL-C value in any of the HD groups, and in contrast to the case in non-HD patients, the risk of MACEs tended to decrease with an increase in the LDL-C

value. These whole data analysis confirmed our findings that lipid managements for HD patients are different from those in non-HD.

Ikewaki et al.[25] reported that LDL and LDL-apoB remain in the blood in HD patients almost twice as long as in normal subjects due to a reduced catabolic rate of apo B, such as that associated with a reduction in LDL being taken up into the liver. Therefore, LDL in HD patients is prone to be modified by oxidation or denaturation in blood vessels, which suggests that large amounts of such modified LDL circulate in the blood of HD patients. Modified LDL-C is not seen in ordinary biochemical exams for blood, but by the characterization of lipid profiles as assessed by isotachoelectrophoresis as we previously reported[26-28], fast migrating (modified or electro-negative) LDL was increased in HD patients, while plasma TC and slow migrating (electro-positive) LDL fractions were within the normal range. In addition, it has also been reported that the amount of time that LDL remains in the blood is extended in chronic kidney disorder (CKD) as the disease progresses[29]. An in vitro experiment suggested that regulation of the pro-apoptotic protein BAD by uremic toxins may increase cardiovascular toxicity[30]. Thus, patients under maintenance HD are in a uremic state and the duration of exposure to uremia is directly related to the duration of HD. Lowering of the serum LDL-C level may not adequately reduce the risk and current lipid management target values may not be useful for preventing MACEs for HD. Pharhaps more comprehensive managements not by statins/lipid controls should be needed[31].

Inflammation and impaired nutrition caused by maintenance HD itself or uremic toxins may be associated with MACEs[30, 32]. The present results were obtained from a medium-term follow-up after PCI, and the main parameter in MACEs was TLR associated with ISR (TLR: 80.8%, death: 15.4%, stent thrombus: 13.5%, MI: 9.6% and TLR-CABG: 3.9%). Therefore, since the present analysis is different from that in an observational cohort study on HD patients, which found that a lower TC was associated with a higher risk of total death, it should not be a problem if we exclude factors such as death associated with impaired nutrition. In HD patients, the inflammatory response tends to be strengthened[33] by increased muscle protein catabolism caused by metabolic acidosis and other complicating inflammatory disease other than inflammation generated by contact between the HD membrane and the blood, and the resulting low energy and malnutrition may reduce immune function, which could lead to further chronic inflammation. Since it has also been reported in systemic erythematosus that chronic inflammation (high C-reactive proteinemia) is associated with the development of new cardiovascular disease[34], increased inflammatory cytokine levels caused by maintenance HD may induce neointimal proliferation at sites where PCI was performed, which could promote MACEs.

The changes in lipoprotein parameters including LDL-C, HDL-C, or non-HDL-C, etc., might be just secondary factors caused by chronic inflammation, and we cannot exclude the possibility that such changes merely reflect the duration and degree of inflammation.

Limitation

Since the present study is a retrospective analysis of patients who underwent PCI from January 2003 to June 2012, the results may need to be further supported by prospective analyses. Since the total number of HD patients was 142, changes in long-term clinical outcomes may also need to be confirmed by increasing both the total number of patients and the duration of follow-up. Since the results of ordinary blood sampling were analyzed retrospectively, the results and discussion might need to be supported by obtaining more detailed laboratory data and collecting additional details including the patient's history of HD.

Conclusion

The results suggest that the application of lipid management for non-HD patients to HD patients at the time of PCI may not necessarily be beneficial for medium-term clinical outcomes, and BMI, prior CABG and insulin use are more useful predictors of MACEs.

Disclosures

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Figure Legends

Fig. 1: Outline of the study (the FU-Registry)

Fig. 2-A: The correlations between lipoprotein parameters and the incidence of MACEs in 1,578 non-HD patients and 142 HD patinets with stable angina.

Fig. 2-B: The correlation between LDL-C and the incidence of MACEs LDL-C was stratified into five groups (LDL-C<80mg/dL, 80-100mg/dL, 100-120mg/dL, 120-140mg/dL and 140mg/dL<LDL-C) in 1,578 non-HD patients and 142 HD patinets with stable angina.

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Table1. Patient characteristics and results of blood tests

	MACEs(-) (n=90)	MACEs(+) (n=52)
Clinical Characteristics at procedure		
Mean age (yrs)	69.5±8.7	68.5±7.4
BMI (%)	21.5±3.8	20.3±2.3*
Male (%)	70.0	75.0
SBP (mmHg)	137.6±23.8	138.5±26.4
DBP (mmHg)	70.4±13.9	68.7±13.0
Pulse rate (/min)	75.9±11.6	78.4±11.4
UCG-LVEF (%)	58.6	53.0*
Clinical characteristics at follow-up		
BMI	21.1±3.2	20.0±1.8*
BMI percent decrease (%)	0.97	0.67
LVEF-UCG (%)	56.8	52.6
Blood tests at PCI procedure		
ALB (mg/dL)	3.9±0.5	3.8±1.0
UA (mg/dL)	6.1±1.7	5.3±1.8 †
TC (mg/dL)	173±44	158±34*
TG (mg/dL)	121±66	122±82
HDL-C (mg/dL)	45.4±13.3	43.1±12.3
Non-HDL-C (mg/dL)	128±41	116±33
LDL-C (mg/dL)	104±36	90±25*
LDL-C /HDL-C	2.5±1.0	2.3±0.8
HbA1c (%)	6.0	5.9
Blood tests at follow-up		
ALB (mg/dL)	3.5±0.2	3.1±0.3
TC (mg/dL)	166±39	150±30*
TG (mg/dL)	117±60	127±70
HDL-C (mg/dL)	47.8±13.5	40.1±14.7 †
LDL-C (mg/dL)	94±33	84±26
LDL-C /HDL-C	2.14	2.43
Non-HDL-C (mg/dL)	117±37	110±27

LDL-C percent decrease (%)	-4.9	-6.9
(Table1. Continued)		
HDL-C percent decrease (%)	9.4	-1.5
Non-HDL-C percent decrease (%)	-1.3	-2.9
HbA1c (%)	6.0±1.2	6.2±1.1
Prior complicating diseases		
Prior PCI (%)	54.4	71.2
Prior CABG (%)	8.9	28.8†
Prior MI (%)	23.3	46.2†
ASO (%)	24.4	25.0
Hypertension (%)	82.2	80.8
Hyperlipidemia (%)	44.4	40.4
Diabetes (%)	62.2	75.0

p value. <0.05=* <0.01=† <0.001=‡

BMI: body mass index, SBP: systolic blood pressure, DBP: diastolic blood pressure. UCG LVEF: ultrasound cardiography left ventricle ejection fraction, ALB: albumin, UA: uric acid, TC: total cholesterol, TG: triglyceride. HDL-C: high density lipoprotein-cholesterol, non-HDL-C: non-high density lipoprotein-cholesterol, LDL-C: low density lipoprotein-cholesterol. L/H ratio: LDL-C/HDL-C, HbA1c: hemoglobin A1c, PCI: percutaneous coronary intervention, CABG: coronary artery bypass graft, MI: myocardial infarction, ASO: arteriosclerosis obliterans, TC percent decrease ={TC(pre)-TC(follow-up)}/TC(pre)×100, LDL-C percent decrease ={LDL-C (pre)-LDL-C (follow-up}/LDL-C (pre)×100, HDL-C percent increase ={HDL-C (follow-up)-HDL-C (pre)}/HDL-C (pre)×100, non-HDL-C percent decrease ={non-HDL-C (pre)-non-HDL-C (follow-up}/non-HDL-C (pre)×100

Table 2. Medications

	MACEs(-) (n=90)	MACEs(+) (n=52)
Medications at PCI procedure		
Ca blocker (%)	51.1	50.0
ACEI (%)	11.2	7.7
B-blocker (%)	13.3	17.3
Statin (%)	26.7	36.5
Nitrate (%)	40.0	36.5
ARB (%)	41.1	50.0
Nicorandil (%)	40.0	36.5
Insulin (%)	24.4	44.2*
DPP-4 inhibitor (%)	2.2	0
Medications at follow-up		
Ca blocker (%)	44.4	55.8
ACEI (%)	6.7	11.6
B-blocker (%)	14.4	19.2
Statin (%)	38.9	38.5
Nitrate (%)	33.3	57.7†
ARB (%)	43.3	48.1
Nicorandil (%)	27.8	42.3
Insulin (%)	24.4	46.2*
DPP-4 inhibitor (%)	1.1	0

p value: <0.05=* <0.01=† <0.001=‡

ACEI: angiotensin converting enzyme inhibitor, ARB: angiotensin receptor blocker, DPP-4 inhibitor: dipeptidyl peptidase-4 inhibitor.

Table3. Lesion characteristics and QCA/IVUS results1

	MACEs(-)	MACEs(+)
Lesion characteristics		
	n=111	n=53
3-vessel disease (%)	50.4	58.5
RCA/LAD/Cx (%)	35.1/42.3/22.6	35.7/45.2/19.1
Pre-In stent restenosis (%)	31.5	49.1*
AHA/ACC type B2+C (%)	72.9	77.4
Severe Calcification (%)	36.0	47.2
DES (%)	64.9	47.2
LMT (%)	4.5	26.4†
QCA		
Pre-procedural results		
	n=56	n=30
Lesion length (mm)	17.4±9.7	19.3±15.9
Bend (%)	28.8	31.7
Reference (mm)	2.7±0.8	2.5±0.6
MLD (mm)	0.7±0.5	0.7±0.3
%DS (%)	70.4	71.6
Post-procedural results		
	n=56	n=30
Reference (mm)	2.6±0.6	2.6±0.6
MLD (mm)	2.0±0.6	2.0±0.6
%DS (%)	28.1	24.8
Stent length (mm)	24.3±13.1	21.5±13.7
Stent reference (mm)	2.9±0.5	2.8±0.5
Stent MLD (mm)	2.5±0.5	2.4±0.5
Stent %DS (%)	14.9	12.1
IVUS post-procedure		
	n=27	n=20
Lesion EEM CSA (mm^2)	12.7±4.5	12.6±5.8
Lesion lumen CSA (mm^2)	6.1±2.7	5.7±1.9

Lesion atheroma CSA (mm^2)	6.8±2.9	7.0±4.8
(Table3. Continued)		
Lesion % plaque (%)	53.0	58.0
Minimum stent CSA (mm^2)	6.2±2.8	5.7±1.9

p-value: <0.05=* <0.01=† <0.001=‡

RCA: right coronary artery, LAD: left anterior descending, Cx: left circumflex branch, MLD: minimum lumen diameter, %DS: percent diameter stenosis, IVUS: intravascular ultrasound, CSA: cross-sectional area, EEM: external elastic membrane.

Table 4. Lesion characteristics, QCA/IVUS results2, and clinical outcomes

	MACE(-)	MACE(+)
Angiographic follow-up results		
	n=97	n=53
In-stent restenosis (%)	9.3	90.6 ‡
Follow-up QCA		
	N=40	N=21
Lesion late loss (mm)	0.20±0.61	0.95±0.87
Lesion %DS (%)	28.5	71.0
Clinical outcomes		
	n=90	n=52
MACEs (%)	0	100
Stent thrombus (%)	0	13.5
Death (%)	0	15.4
MI (%)	0	9.6
TLR-PCI (%)	0	80.8
TLR-CABG (%)	0	3.9

p value: <0.05=* <0.01=† <0.001=‡

MACEs: major adverse cardiovascular events, MI : myocardial infarction, TLR-PCI: target lesion restenosis-percutaneous coronary intervention, TLR-CABG: target lesion restenosis-cardiac artery bypass graft

Table5. Multivariate logistic regression analysis

	MACE(+)
Parameters	OR(95%CI)
BMI	0.83(0.69-0.99) *
UCG-LVEF	0.99(0.95-1.03)
UA	0.84(0.63-1.12)
LDL-C	0.99(0.98-1.01)
Prior CABG	3.54(1.02-13.43) *
Prior MI	1.76(0.65-4.81)
Insulin	3.37(1.18-10.25) *

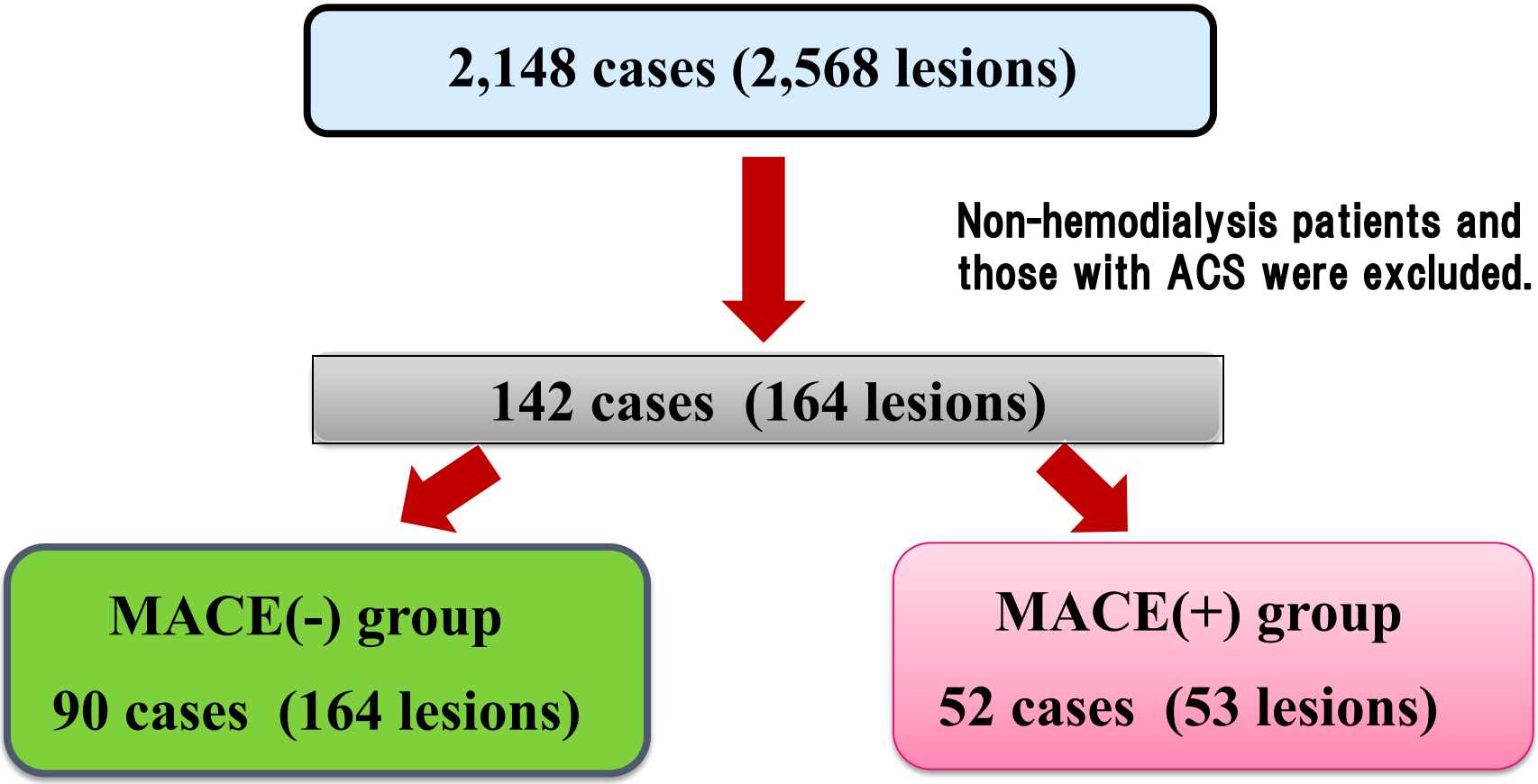
p value: <0.05=* <0.01=† <0.001=‡

BMI: body mass index, UCG LVEF: ultrasound cardiography left ventricle ejection fraction, UA: uric acid, LDL-C: low density lipoprotein-cholesterol, CABG: coronary artery bypass graft, MI: myocardial infarction.

Fig. 1

Outline of the study

FU-Registry



The average duration of follow-up was 300 days.

Fig. 2-A

FU-Registry

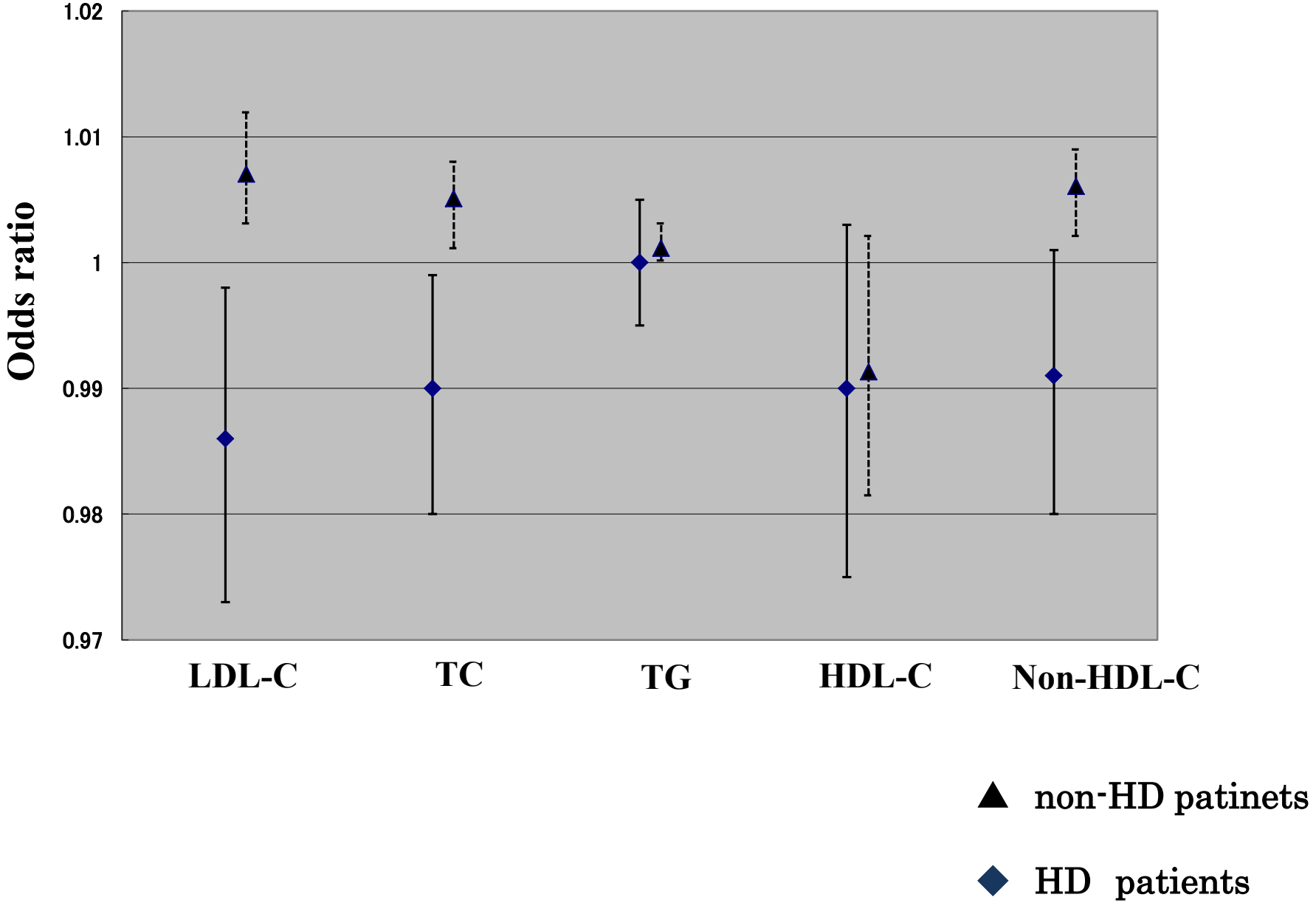


Fig. 2-B

FU-Registry